Embedded Solutions

DC2 – Rugged Panel Computer with Touch

Configuration example

User Manual

mikro elektronik
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DC2 – Rugged Panel Computer with Touch

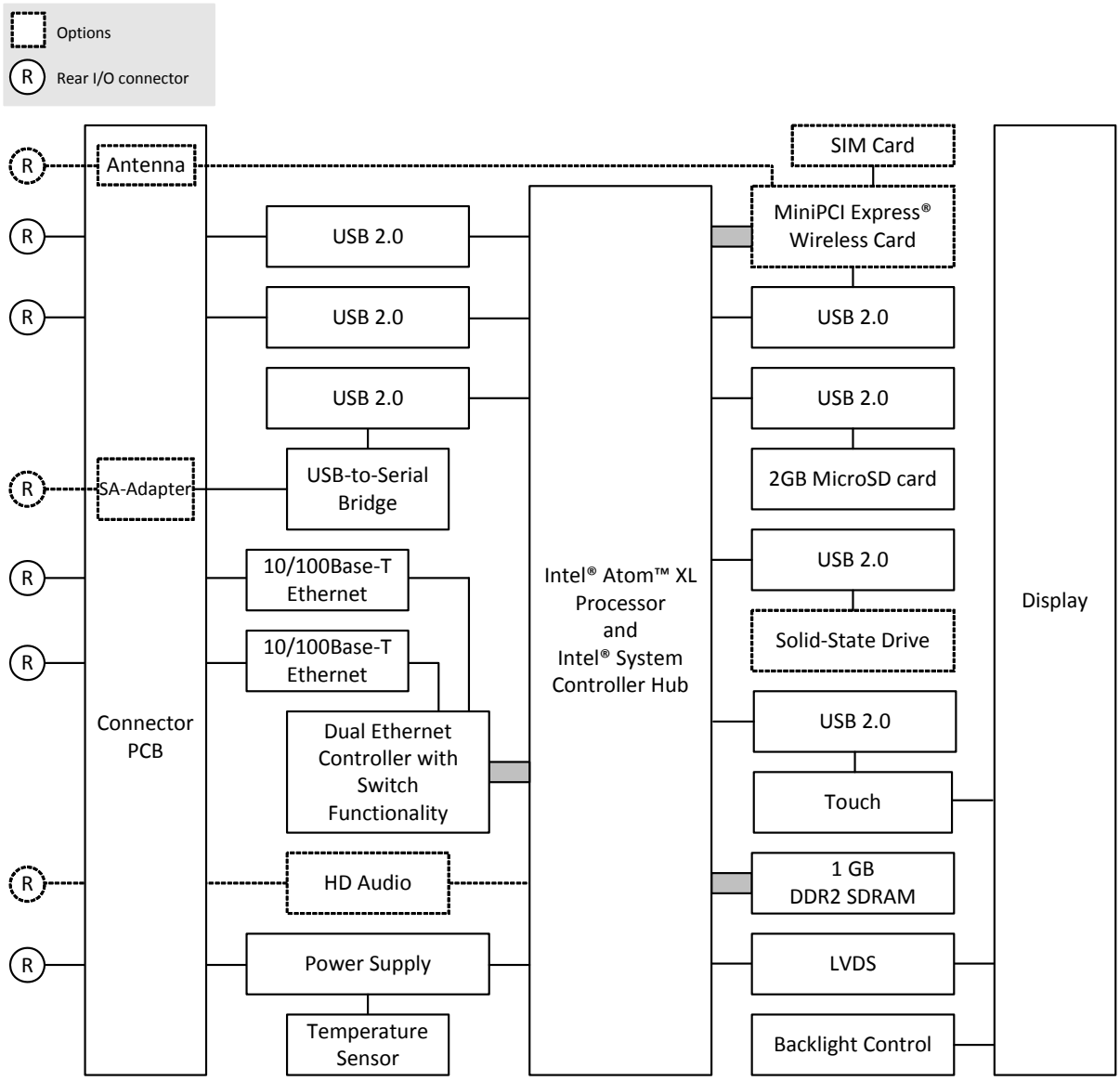
The panel PC DC2 is a rugged, fanless and maintenance-free human-machine interface for interactive applications in transportation and industrial automation. It is designed for panel mounting and equipped with a 10.4" 4:3 LCD TFT display with a capacitative touch panel.

The DC2 is controlled by the Intel® Atom™ XL Z520PT running at 1.33 GHz and comes with 1 GB of DDR2 SDRAM and a built-in 2GB microSD™ card. The standard interfaces comprise 2 Fast Ethernet (via RJ45 connectors) and 2 USB ports as well as four binary inputs (via the 10-pin power supply connector). The two Ethernet interfaces have switch functionality to provide Ethernet connection to subsequent intelligent displays. A temperature sensor is provided to monitor and control the display. All I/O signals are concentrated at the bottom of the unit.

The DC2 is equipped with an internal 9 to 36 V (12 VDC nom. or 24 VDC nom.) wide-range power supply and able to operate in a -40 to +70°C environment (+85°C for 10 minutes). It complies with the EN 50155, class Tx railway standard when used with an optional includable PSU suited for railway applications. All electronic components are soldered to withstand shock and vibration and prepared for conformal coating.

The unit's control electronics are directly attached to the back of the display, hence bigger screen sizes or other aspect ratios can be realized easily. Further options include other types of the Intel® Atom™ XL processor, M12 connectors for the Ethernet interfaces, a serial interface or GPS adapter that can be added via an SA-Adapter™, HD audio via a D-Sub connector and an antenna connector. A MiniPCI Express® card slot (with a SIM card slot) in combination with an external antenna can be used to incorporate wireless functions like WIFI, WIMAX, GSM/GPRS, UMTS etc.

Block Diagram



Technical Data

CPU

- Intel® Atom™ Z520PT
  - 1.33 GHz processor core frequency
  - 533 MHz system bus frequency
- Chipset
  - Intel® system controller hub US15W

Display

- Screen size: 10.4"
- Resolution: 1024 x 768 (XGA) with aspect ratio 4:3
- Luminance (cd/m^2): 350 cd/m^2
- Contrast: 1200:1
- Response time: Ton+Toff average 25 ms
- Viewing angle: 176°(H)/176°(V)
- Backlight with brightness control
- Interface: LVDS
- Visible screen area: 215.4 x 161.8 mm
- Monitored and controlled by a board management controller
  - Display is turned off at extreme temperatures

Touch functionality

- Capacitive touch panel
- USB-driven touch interface
- Anti-glare layer

Memory

- 1GB DDR2 SDRAM system memory
  - Soldered
  - 533 MHz memory bus frequency
- microSD card slot
  - 2GB microSD card

I/O

- USB
  - Two USB 2.0 host ports
  - Accessible via Series A connectors
  - UHCI implementation
  - Data rates up to 480Mbits/s
- Ethernet
  - Two 10/100Base-T Ethernet channels
  - Accessible via RJ45 connectors
  - Switch functionality

- Binary inputs
  - Four universal binary inputs via 10-pin power connector, e.g., for geographical addressing

Intelligent Power Supply with Controller

- Input voltage supervision
- Temperature supervision via LM50 sensor
- Backlight control (turns off display at configurable temperatures)
- Buffer functionality for RTC and BIOS CMOS (for up to 72 h)
- Reset of CPU board possible
- Wake on time
- Watchdog
- Accessible via SMBus

Electrical Specifications

- Supply voltage:
  - 12 VDC nom. or 24 VDC nom. (9 to 36 V)
- Power consumption:
  - 12 W typ.

Mechanical Specifications

- Dimensions: 267 mm x 187.7 mm x 85 mm (electronics), 310 mm x 235 mm (display frame)
- Weight: 2.3 kg
- Designed for panel mounting
- Front protected according to IP65
- Rear protected according to IP40

Environmental Specifications

- Temperature range (operation):
  - -20 to +70°C for the display panel (with automatic switch-off of the display at excess temperatures)
  - -40°C to 70°C, with up to 85°C for 10 minutes according to class Tx (EN50155) for the computer
  - Display is turned off at extreme temperatures
  - Conductive cooling
  - Fanless operation
- Temperature range (storage): -40..+85°C
- Relative humidity (operation): max. 95% non-condensing
- Relative humidity (storage): max. 95% non-condensing
- Altitude: -300 m to + 3,000 m
- Shock: according to EN 50155 (10.2.11)
- Vibration: according to EN 50155 (10.2.11)

MTBF

- 85,050.85 h @ 40°C according to IEC/TR 62380 (RDF 2000)

EMC

- Conforming to EN 50155, EN 50121-3-2/EN 61000-4-5
- e1 certified by the German Federal Motor Transport Authority

Software Support

- Windows® XP Embedded image included (120-day trial version)
- For more information on supported operating system versions and drivers see online data sheet.

Configuration Options

CPU

- Intel® Atom™ Z530P, 1.6GHz, 533MHz FSB
- Intel® Atom™ Z510P, 1.1GHz, 400MHz FSB
- Intel® Atom™ Z520PT, 1.33GHz, 533MHz FSB
- Intel® Atom™ Z510PT, 1.1GHz, 400MHz FSB

Display

- Screen size 12", 15", 17" or 19"
- Other aspect ratios (e.g. 16:10, 15:9)
- Various resolutions up to 1900x1200
- Backlight control via brightness sensor

Memory

- SATA hard disk drive or solid-state drive
- USB Flash solid-state drive
- 2nd microSD card slot

I/O

- Ethernet
  - 2 Fast Ethernet on M12 connectors
- HD audio
  - HD audio codec
  - Audio stereo in
  - Audio stereo out
  - SPDIF out
  - All available via 9-pin D-Sub connector
- Serial interface
  - 1 serial interface realized via SA-Adapter™, e.g., RS232 or RS422, isolated or not, IBIS, GPS
- Status LEDs
  - Ethernet and general status / error messages

Mini PCI Express® card slot

- For functions like WIFI, WIMAX, GSM/GPRS, UMTS
- PCI Express® or USB interface
- Accessible via, e.g., a reverse SMA connector

Electrical Specifications

- Additional includable PSU suited for railway applications (EN 50155 compliant)

Mechanical Specifications

- Front protected according to IP67

Software

- Linux

Please note that some of these options may only be available for large volumes. Please ask our sales staff for more information.

For available standard configurations see online data sheet.

Product Safety

Handling Instructions

- Do not open the DC2. All repairs and changes to the system's internals must be executed by authorized MEN personnel only.
- Do not drop the DC2. Although it is rugged, falls from a considerable height will likely cause damage to the system.
- Do not install the DC2 near any heat sources (e.g. radiators, heat registers).
- Keep the DC2 away from liquids. Avoid exposure to dripping or splashing.
- Never handle the system or any connected cables with wet hands.
- Make sure that all peripheral devices are connected to the DC2 before connecting an external power supply and switching on the system.
- The heat sink on the rear of the DC2 may get warm after prolonged use. This is normal.

Electrostatic Discharge (ESD)

Computer boards and components contain electrostatic sensitive devices. Electrostatic discharge (ESD) can damage components. To protect the board and other components against damage from static electricity, you should follow some precautions whenever you work on your computer.

- Power down and unplug your computer system when working on the inside.
- Hold components by the edges and try not to touch the IC chips, leads, or circuitry.
- Use a grounded wrist strap before handling computer components.
- Place components on a grounded antistatic pad or on the bag that came with the component whenever the components are separated from the system.
- Store the board only in its original ESD-protected packaging. Retain the original packaging in case you need to return the board to MEN for repair.

About this Document

This user manual describes the hardware functions of the system and connection of peripheral devices. It also provides additional information for special applications and configurations of the board.

The manual does not include detailed information on individual components (data sheets etc.). A list of literature is given in the appendix.

History

Issue	Comments	Date
E1	First issue	2011-01-21
E2	Now with e1 certification Cosmetics	2011-01-26

Conventions

This sign marks important notes or warnings concerning proper functionality of the product described in this document. You should read them in any case.

italics — Folder, file and function names are printed in *italics*.

bold — **Bold** type is used for emphasis.

`monospace` — A `monospaced` font type is used for hexadecimal numbers, listings, C function descriptions or wherever appropriate. Hexadecimal numbers are preceded by "0x".

hyperlink — Hyperlinks are printed in blue color.

The globe will show you where hyperlinks lead directly to the Internet, so you can look for the latest information online.

IRQ#
/IRQ — Signal names followed by "#" or preceded by a slash ("/") indicate that this signal is either active low or that it becomes active at a falling edge.

in/out — Signal directions in signal mnemonics tables generally refer to the corresponding board or component, "in" meaning "to the board or component", "out" meaning "coming from it".

Vertical lines on the outer margin signal technical changes to the previous issue of the document.

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1 Getting Started

This chapter gives an overview of the system and some hints for first installation.

1.1 Layout of the DC2

Figure 1. *The DC2 - front view*

Note: The dot visible close to the top-right corner of the display panel is a cut-out for the optional brightness sensor.

Figure 2. *The DC2 - bottom view*

Interfaces at the bottom of the DC2 (from left to right):

- Optional antenna connector (not assembled)
- 10-pin power supply connector (with binary inputs)
- 2x USB
- 2x Ethernet
- Optional serial interface (GPS interface shown)
- Optional audio (not assembled)
- Earthing stud

1.2 Earthing Stud

The DC2 features an earthing stud on the bottom right (see Figure 2, The DC2 - bottom view). An earth connection is essential for the system to meet its EMC specifications.

Always connect an earthing cable with a cross section of at least 0.75 mm² to the earthing stud before any other connections! When disassembling the system, make sure the earthing cable is detached last.

Make sure to connect the cable with all the included washers and the nut in the correct order as pictured below to ensure that the system meets its EMC specifications:

Nut -> star washer -> flat washer -> earth connection -> lock washer (teeth toward system)

1.3 First Operation

You can use the following check list when starting the system for the first time.

- ☑ Connect a USB keyboard and mouse to the USB connectors of the DC2.
- ☑ Power-up the system.
- ☑ You can start up the BIOS setup menu by hitting the <DEL> key (see Chapter 4 BIOS on page 36).
- ☑ Now you can make configurations in BIOS (see Chapter 4 BIOS on page 36).
- ☑ Observe the installation instructions for the respective software.

1.4 Installing Operating System and Driver Software

The DC2 comes with a 120-day trial version of Windows XP Embedded and all necessary drivers pre-installed on the microSD card.

During the first power up of the system, the resealing process of the Windows XP Embedded image will be started automatically, including a system reboot. This will take approximately 5 minutes. No action on behalf of the user is necessary at this time. The 120-day trial period starts the moment the resealing process has finished setting up the system.

Please note that the gold-cap-powered internal clock of the DC2 is used to determine how much of the trial period remains.

The following events can cause the trial period to end prematurely:

- The BIOS time is modified.
- The Windows time is modified.
- A BIOS update has unforeseen side-effects.

Should any of this happen and render the trial version of Windows XP Embedded unusable prematurely, please contact MEN.

A board support package (BSP) containing all the necessary, hardware-specific components to create an individualized Windows XP Embedded is available on MEN's website. A complete log of the standard Windows XP Embedded image used on the DC2 is available from MEN on request.

1.5 Mounting the DC2

The DC2's front panel provides four mounting holes for panel installation. Use M5 countersink head screws. Refer to Figure 3, Front panel dimensions and mounting hole positions for exact measurements.

Figure 3. *Front panel dimensions and mounting hole positions*

2 Functional Description

2.1 Interfaces

All interfaces are available at the bottom of the DC2, see Figure 2, The DC2 - bottom view on page 17.

2.1.1 Power Supply

The DC2 is supplied with a nominal voltage of 12 V or 24 V (9..36 VDC). All other required voltages are generated onboard. The DC2 provides one 10-pin spring-type terminal that is also used for the unit's binary inputs.

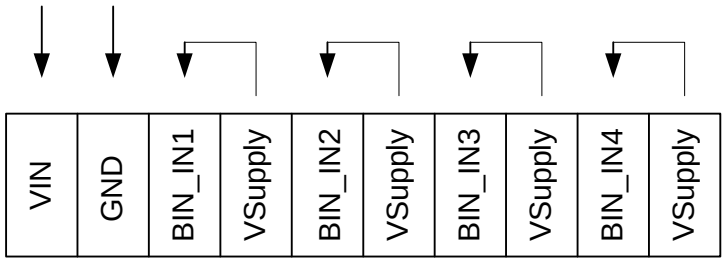
Table 1. *Power supply VCC / coding connector pin assignment*

	Pin	Name	Description
	1	9-36VDC	Power input
	2	IGND	GND power input
	3	BININ0	Binary0 coding input
	4	V_IN(BININ)	VSupply and BININ0 supply
	5	BININ1	Binary1 coding input
	6	V_IN(BININ)	VSupply and BININ1 supply
	7	BININ2	Binary2 coding input
	8	V_IN(BININ)	VSupply and BININ2 supply
	9	BININ3	Binary3 coding input
	10	V_IN(BININ)	VSupply and BININ3 supply

2.1.2 Binary inputs

The DC2 provides 4 binary inputs. The maximum input voltage is 36 VDC. The threshold voltage is 6 V. The binary inputs are protected via suppressor diodes. To provide a simple circuit, the inputs are realized without galvanic isolation. The binary inputs are connected to the BMC. ESD and burst protection according EN50155 is guaranteed. To provide a coding function with the binary inputs, the supply voltage is connectable to the binary inputs with a cable bridge on the connector.

Figure 4. *Coding connector*



2.1.3 USB Interface

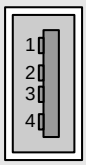
The DC2 provides two USB 2.0 interfaces. They are controlled by one EHCI controller for USB 2.0 in the System Controller Hub.

The ports also support USB 1.1.

Connector types:

- 4-pin USB Series A receptacle according to Universal Serial Bus Specification Revision 1.0
- Mating connector:
  4-pin USB Series A plug according to Universal Serial Bus Specification Revision 1.0

Table 2. *Pin assignment of USB connectors*

	1	+5V
	2	USB_D-
	3	USB_D+
	4	GND

2.1.4 Ethernet Interface

The DC2 comes with two Fast Ethernet ports with switch functionality. They are available through standard RJ45 connectors.

Both half and full duplex mode are supported. Switching functionality is provided for forwarding of Ethernet frames to subsequent intelligent displays. The DC2 also supports powerless forwarding of Ethernet frames: The unit's onboard switch is bypassed when the Ethernet circuit is not supplied with its intended voltage. Thus, a switched off or defective DC2 unit does not interrupt the Ethernet traffic in a daisy chain configuration.

Note that the two Ethernet ports are connected via a relay while the DC2 is in powerless state, so connecting both to the same switch will likely jam the network.

Table 3. *Pin assignment of the standard 8-pin RJ45 Ethernet connectors*

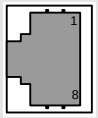
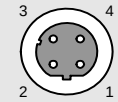
	Pin	Name	Description
	1	RX+	Receiver positive input
	2	RX-	Receiver negative input
	3	TX+	Transmitter positive output
	4	-	
	5	-	
	6	TX-	Transmitter negative output
	7	-	
	8	-	

Table 4. *Pin assignment of the optional M12 Ethernet connectors*

	Pin	Name	Description
	1	TX+	Transmitter positive output
	2	RX+	Receiver positive input
	3	TX-	Transmitter negative output
	4	RX-	Receiver negative input

The Ethernet controller has its own EEPROM to store the MAC address etc.

The unique MAC address is set at the factory and should not be changed. Any attempt to change this address may create node or bus contention and thereby render the unit inoperable. The MAC address on the DC2 is:

- LAN0: `0x 00 C0 3A A4 xx xx`

where "`00 C0 3A`" is the MEN vendor code, "`A4`" is the MEN product code and "`xx xx`" is the hexadecimal serial number of the DC2's carrier board, e. g. "... `00 2A`" for the serial number "000042".

For the unit's serial number please refer to Chapter 6.2 Finding out the Product's Article Number, Revision and Serial Number on page 58.)

2.1.5 Serial Interface via SA-Adapter (optional)

As an option, the system offers the possibility to provide a serial interface via an MEN standard SA-Adapter. This way, a serial interfaces can be used which can be flexibly configured as needed, e.g., RS232 or RS422, isolated or not, IBIS or GPS.

2.1.6 HD Audio (optional)

The DC2 supports an optional high definition audio interface.

Table 5. *Pin assignment of the HD audio interface*

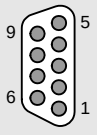
	9	AUDIO_IN_R	5	AUDIO_SPDIF
	8	AUDIO_GND	4	AUDIO_IN_L
	7	AUDIO_OUT_R+	3	AUDIO_OUT_R-
	6	AUDIO_OUT_L-	2	AUDIO_GND
			1	AUDIO_OUT_L+

Table 6. *Signal mnemonics of the HD audio interface*

Signal	Direction	Description
AUDIO_EXT_OUT_L±/R±	out	Line out, left and right, differential signal pairs
AUDIO_EXT_IN_L/R	in	Line in, left and right
AUDIO_EXT_GND	-	Analog ground
AUDIO_EXT_SPDIF	out	S/PDIF output

2.1.7 Wireless Interface (optional)

A PCI Express Mini card can be used to incorporate wireless functions like WIFI, WIMAX, GSM/GPRS or UMTS. A SIM card slot is also available.

Please note that PCI Express Mini cards and SIM cards must be installed by authorized MEN personnel only. Do not open the DC2!

2.2 Brightness Sensor (optional)

As an option, the DC2 can be equipped with a photo diode as brightness sensor for environmental light using an optical fiber led to, e.g., the unit's display frame. As an alternative, a cabled photo diode can also be used.

2.3 Capacitive Touch Panel

The DC2 is equipped with a USB-driven capacitive touch panel. The touch panel provides an anti-glare surface to avoid reflections.

Note that the capacitive technology used for the touch panel makes usage with gloves or tools impossible.

2.4 Board Supervision

The DC2 provides two intelligent board management controllers (BMC) with the following main features:

- Board power sequencing control
- Voltage supervision
- System watchdog
- Software reset functionality
- Error state logging
- Power mode settings
- SMBus communication with main CPU

The watchdog device monitors the board on operating system level. If enabled, the watchdog must be triggered by application software. If the trigger is overdue, the watchdog initiates a board reset and this way can put the system back into operation when the software hangs.

The watchdog uses a configurable time interval or is disabled. Settings are made through BIOS or via an MEN software driver.

In addition, the DC2 uses a National LM95245 device to measure the CPU die temperature and the local board temperature.

MEN provides dedicated software drivers for the board controller and LM95245 device. For a detailed description of the functionality of the driver software please refer to the drivers' documentation.

You can find any driver software and documentation available for download on MEN's website.

2.5 Reset

The DC2 generates its own reset signal. You can wake it up from reset state by externally switching the power supply off and on.

2.6 Real-Time Clock

The supply voltage for the RTC is buffered with a capacitor that provides at least 72 hours buffer time at 40°C.

2.7 Processor Core

The standard model of the DC2 is equipped with an Intel Atom Z520PT (1.33 GHz) processor. The following table gives a performance overview:

Table 7. *Processor core options on DC2*

Processor Type	Core Frequency	L2 Cache	Front Side Bus
Atom Z510P	1.1 GHz	512 KB	400 MHz
Atom Z530P	1.6 GHz	512 KB	533 MHz
Atom Z510PT	1.1GHz	512 KB	400MHz
Atom Z520PT	1.33GHz	512 KB	533MHz

2.8 Memory

2.8.1 DRAM System Memory

The system provides 1 GB on-board, soldered DDR2 (double data rate) SDRAM. The memory bus is 64 bits wide (one channel) and operates with up to 533 MHz.

2.8.2 Boot Flash

The DC2 has an 8-Mbit LPC Firmware Hub (FWH) implemented as on-board Flash for BIOS data.

2.8.3 EEPROM

The system has a 2-kbit serial EEPROM for factory data.

2.9 Graphics

The DC2 provides a 4-bit LVDS interface with a 112MHz maximum pixel clock. It supports a resolution of up to 1366x768 pixels (the resolution of the system's standard display panel is 1024x768). As an option, the controller board of the DC2 also provides a second 8-bit LVDS interface that goes up to 1920x1200.

2.10 Mass Storage

2.10.1 microSD Card

The DC2 provides an internal USB-driven 4-bit slot for a standard microSD card. By default, the system comes with a 2GB microSD card. A second microSD card slot is optional.

2.10.2 Serial ATA (SATA) Hard Disk or Solid-State Drive (optional)

The DC2 provides one internal SATA interface that supports transfer rates up to 100 MB/s for optional hard disk or solid-state drives.

2.10.3 USB Flash SSD (optional)

Another optional mass storage solution for the DC2 is a USB-driven Flash SSD (solid state drive).

2.11 Ethernet and General Status LEDs (optional)

Figure 5. *Position of optional LEDs near USB and Ethernet connectors*

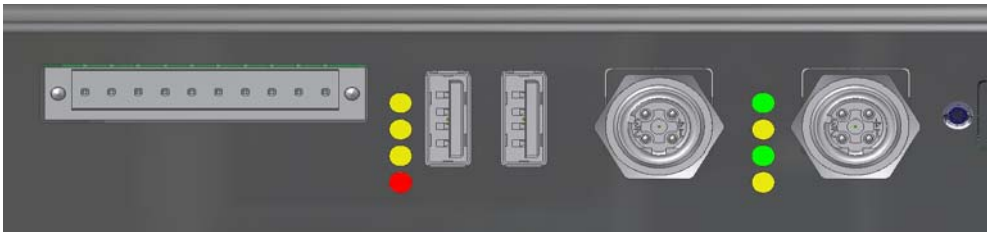


Table 8. *Ethernet and general status LEDs (from top to bottom as depicted above)*

LED	Description	LED	Description
ADD 1	Additional LED 1	**LNK 1**	Port 1 (right) link
ADD 2	Additional LED 2	**ACT 1**	Port 1 (right) activity
BMC 1	BMC 1 status	**LNK 2**	Port 2 (left) link
BMC 2	BMC 2 status	**ACT 2**	Port 2 (left) activity

As an option, the DC2 is available with a total of eight status LEDs. Two status LEDs are available for each Ethernet channel. They signal the link and activity status (different LED behavior can be realized on demand).

The other four LEDs are general status LEDs connected to the system's board management controllers. The red status LED is switched on when the BIOS starts, switched off when the system is switched off and flashing when the system is in stand-by (S3) status. It is also used to display error messages in case of a system failure (see Table 9, Error codes signaled by BMC via LED flashes (red BMC 2 status LED)). During normal operation the red status LED can be switched on and off via the MEN driver for the XM01BC board controller.

The second BMC status LED is yellow and lights up when the input voltage is within valid range. It will blink slowly to indicate an automatic shutdown of the system in case of excessive input voltage or temperature levels. It is controlled by the XC02BC board controller.

The remaining two LEDs are yellow and can be used freely depending on an application's requirements.

In case of a board failure, the red status LED displays the following error messages:

Table 9. *Error codes signaled by BMC via LED flashes (red BMC 2 status LED)*

Number of Flashes	Error	Description
1	XM01BCI_ERR_CTSTRPHC_SHTDWN	Catastrophic shutdown
2	XM01BCI_ERR_INP_TOO_LOW	Input voltage too low
3	XM01BCI_ERR_INP_TOO_HIGH	Input voltage too high
4	XM01BCI_ERR_NO_ATX_PWR_OK	External power supply failure
5	XM01BCI_ERR_NO_PWRGD_5130_1	3.3 V internal voltage failure
6	XM01BCI_ERR_NO_DDRVR_PWRGD	Memory voltage failure
7	XM01BCI_ERR_NO_PWRGD_5130_2	1.5 V or 1.05 V internal voltage failure
8	XM01BCI_ERR_NO_PM_CPU_PWRGD	CPU voltage failure
9	XM01BCI_ERR_BIOS_TIMEOUT_1	First BIOS timeout
10	XM01BCI_ERR_BIOS_TIMEOUT_2	Second BIOS timeout
11	XM01BCI_ERR_BIOS_TIMEOUT_3	Third BIOS timeout
12	XM01BCI_ERR_BIOS_TIMEOUT_4	Fourth BIOS timeout
13	XM01BCI_ERR_CPU_RST_TIMEOUT	CPU_RST timeout
255	CPUBCI_INVALID_MAIN_STATE	Invalid PIC main state

3 Firmware Functions

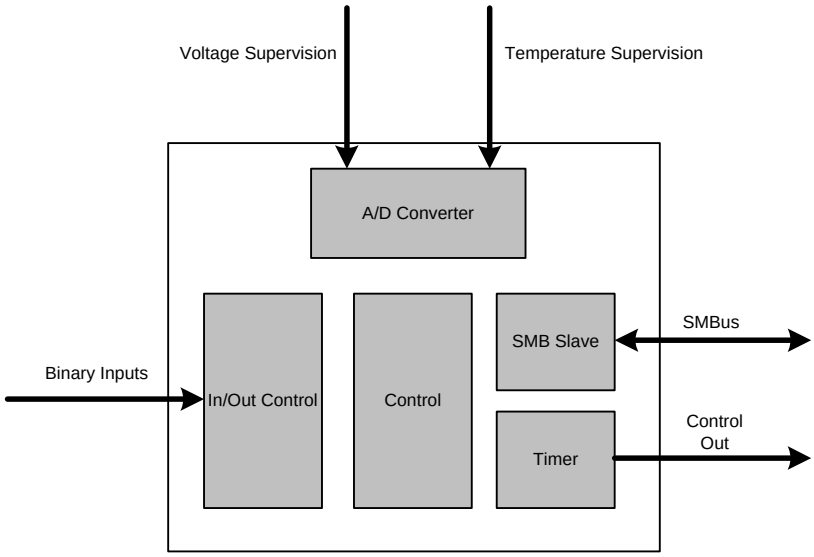
The functions of the XC02BC board controller (BMC1) described in the following chapter depend on the firmware. This user manual describes the functions as realized in the current MEN standard firmware. To access the functions described below from own applications, MEN provides the Windows Installset 13XM01-77 and an OS-independent MDIS driver package, 13XC02-06. Please also refer to the general MDIS documentation for details.

3.1 Onboard Microcontroller

The DC2 is equipped with an intelligent internal power supply. Its onboard microcontroller is used as a control and supervision device of the DC/DC converter, the binary inputs of the DC2, its temperature and its display. Additionally, it is used as a watchdog for the CPU and the microcontroller itself. The microcontroller is connected to the CPU via SMBus. It is able to keep the power supply active even if the external on/off-signal goes inactive. The microcontroller controls the reset signal to be able to reset the CPU.

Windows XP Embedded, the pre-installed operating system of the DC2, needs a controlled power down sequence. The power supply of the CPU can be kept active via the SMBus even when the external on/off signal of the DC2 is inactive so that a controlled power down of the operating system is possible. For further information see Chapter 3.2.7.1 Off Delay on page 32.

Figure 6. *Microcontroller block diagram*



3.2 SMBus Functionality

3.2.1 SMBus Interface

The DC2's internal power supply supports SMBus slave device functionality. The 7-bit SMBus address of the power supply unit is 0x09. Its microcontroller behaves according to the SMBus Specification Version 2.0. The supported SMBus commands and their functions are explained in the following chapters. The commands are listed by their unique name. The "Data Range" column lists the valid range of the data byte for the specific command code. The "Type" column specifies the data direction for the specific command. 'r' specifies that the host can read the data using the SMBus read-byte protocol. 'w' means the host can write data using the SMBus write-byte protocol.

3.2.2 Wake On Time

The DC2 can be switched on/off by a programmable timer. The timer is included in the internal power supply unit's microcontroller and is programmable by the CPU via SMBus commands (see Table 10, SMBus commands for wake on time function, on page 28).

The behavior after power up by wake on time is identical to the behavior after power up by key input. After the first wake on time event, the wake on time feature is disabled.

Note: For the timer functionality it is necessary that the DC/DC converter and the microcontroller are active, i.e. the power supply unit is connected to the DC/DC converter, which is supplied with power. The DC2 will consume approx. 800 mW in this state.

Table 10. *SMBus commands for wake on time function*

Name	Command Code	Data Range	Type	Description
XC02C_WOT_L	0x00	0x00.. 0xFF	r/w	Wake on time low byte
XC02C_WOT_H	0x01	0x00.. 0xFF	r/w	Wake on time high byte

The wake on time delay can be configured via SMBus in a 16 bit counter to provide the range according to the following table:

Table 11. *SMBus commands XC02C_WOT_L / XC02C_WOT_H*

Minimum	Maximum	Description
0 (OFF) (default)	65,535 min (45d 12h 15m)	*XC02C_WOT_L* and *XC02C_WOT_H* build a 16 bit value which represents the time in minutes

A user application that shall switch on the DC2 on a given date and time needs to calculate the amount of minutes between shutdown and desired wake time.

3.2.3 Watchdog

The internal power supply unit's microcontroller is also used as a watchdog for the DC2 system.

It is possible to enable/disable the watchdog by the SMBus command *XC02C_WDOG_STATE*. After the *XC02C_STATUS* byte (see Table 16, SMBus commands for shutdown delay, on page 31) signals a shutdown, the watchdog is disabled by the firmware. The watchdog is triggered by cyclic SMBus commands (*XC02C_WDOG_TRIG*) from the CPU. The time interval between trigger commands is configurable via the SMBus command *XC02C_WDOG_TOUT* (see Table 13, SMBus command XC02C_WDOG_TOUT, on page 29). The time interval is set to its maximum value after DC2 power up and the watchdog is disabled. In case of a missing trigger unit's microcontroller resets the complete system. The number of missing SMBus trigger command exceptions is incremented and can be read via the SMBus command *XC02C_WDOG_ERR*.

After three exceptions, the microcontroller switches off the power output (V_{out}) and switches off the display.

Table 12. *SMBus commands for the watchdog function*

Name	Command Code	Data Range	Type	Description
XC02C_WDOG_STATE	0x05	0x00, 0x01	r/w	Watchdog state
XC02C_WDOG_TRIG	0x06	0	w	Watchdog trigger signal
XC02C_WDOG_TOUT	0x07	0x01.. 0xFF	r/w	Watchdog timeout in 100ms steps
XC02C_WDOG_ERR	0x08	0x00.. 0x04	r	Number of missing on watchdog trigger signals

Table 13. *SMBus command XC02C_WDOG_TOUT*

Value	Watchdog Timeout
1	100 ms
2	200 ms
3	300 ms
...	
255	25.5 s (default)

3.2.4 Status of Binary Inputs

The status of the binary inputs is also signaled via SMBus commands. See Table 14, SMBus commands for binary inputs status, on page 30.

Table 14. *SMBus commands for binary inputs status*

Name	Command Code	Data Range	Type	Description
XC02C_IN	0x0E	0x00.. 0x1F	r	State of binary inputs

The binary inputs represent the status of the key input and the 4 geographical address inputs that allow a user application to find out e.g. where in a train a DC2 is located.

3.2.5 Key Input

One of the binary inputs serves as an on/off input. When this signal is passive (open) during power up of the input voltage, the system is not supplied with power. When this signals goes active, the microcontroller switches the power supply to provide the system with power. Regardless of the key input signal, the DC/DC converter and the microcontroller are always supplied with power when the input voltage is connected.

Note that key input functionality is only available when using a customized power supply, as the key input signal from the included external power supply is always active.

3.2.5.1 Key Input On

The microcontroller switches on the system power whenever the debounced state of the key binary input switches from low to high state (On event). The microcontroller debounces the key input in the following way: if the input is stable for 250ms, the input state is interpreted.

3.2.6 Shutdown

3.2.6.1 Shutdown by Software

At any time it is possible to shut down the power supply by software via SMBus command *XC02C_SWOFF*. A shutdown by software is caused when an SMBus byte write of 0x09 (command) and 0xA8 (magic value to avoid unintended shutdowns) is done to the microcontroller's address.

Table 15. *SMBus command for shutdown by software function*

Name	Command Code	Data Range	Type	Description
XC02C_SWOFF	0x09	0xA8 (magic)	w	Signal a software power off from application

3.2.6.2 Shutdown by Key Input

When using a customized power supply, it is possible at any time to shut down the power supply by switching off the key input. A shutdown by key input follows the shutdown sequence.

3.2.7 Shutdown Delay

During the shutdown sequence the microcontroller provides a programmable shutdown delay. The default state of the shutdown delay after power up of the DC2 is 0 (disabled). The shutdown delay is configurable via the SMBus command *XC02C_DOWN_DELAY*, see Table 16, SMBus commands for shutdown delay, on page 31 and Table 18, SMBus command XC02C_DOWN_DELAY, on page 31. The shutdown delay timer is started after shutdown event. At any time during the shutdown delay the shutdown sequence can be stopped by an On event (key input on). The system is in running state then and the shutdown delay timer is cleared.

Table 16. *SMBus commands for shutdown delay*

Name	Command Code	Data Range	Type	Description
XC02C_DOWN_DELAY	0x0B	0x00.. 0x07	r/w	Shutdown delay
XC02C_STATUS	0x0D	0x00.. 0x01	r	Signal PSU status to application

Table 17. *SMBus command XC02C_STATUS*

Bit	Value	Description
0	0	Shutdown event not signaled
	1	Signal shutdown event
1	0	Normal operation
	1	Display in protect state (over/under-voltage or temperature)
2..7	0	Reserved

Table 18. *SMBus command XC02C_DOWN_DELAY*

Value	Shutdown Delay
0	0 min
1	1 min
2	2 min
3	4 min
4	8 min
5	16 min
6	32 min
7	64 min

3.2.7.1 Off Delay

During the shutdown sequence the microcontroller provides a programmable Off delay. As default this feature is not enabled (mode 0). In this case there will be no Off delay, the supply will be switched off immediately. When enabled (mode 1…5), the microcontroller starts the Off delay timer after signaling the shutdown event to the CPU. After timeout the microcontroller switches off the supply voltage (V_{out}). V_{out} is kept disabled for at least 1 s, even if an immediate On event occurs. This guarantees a proper power on reset of the supplied system. The Off delay can be programmed using the SMBus command *XC02C_OFF_DELAY*, for details see Table 19, SMBus command for Off delay function, on page 32 and Table 20, SMBus command XC02C_OFF_DELAY, on page 32.

Table 19. *SMBus command for Off delay function*

Name	Command Code	Data Range	Type	Description
XC02C_OFF_DELAY	0x0C	0x00.. 0x05	r/w	Off delay

Table 20. *SMBus command XC02C_OFF_DELAY*

Mode value	Off Delay
0	Feature off (no Off delay, default)
1	1 min
2	2 min
3	4 min
4	8 min
5	16 min

3.2.7.2 Off Acknowledge

The microcontroller provides a possibility to acknowledge the shutdown. It is possible at any time during Off delay to shut down the power supply by the SMBus command *XC02C_OFFACK*.

Table 21. *SMBus command for Off acknowledge function*

Name	Command Code	Data Range	Type	Description
XC02C_OFFACK	0x0A	0	w	Signal Off acknowledge

3.2.8 Voltage Supervision

Input and output voltage are supervised by the microcontroller. The microcontroller supervises the 12 V output voltage of the DC/DC converter by applying it through a voltage divider to one ADC channel. The supervision ranges are set by the commands XC02C_VOLT_HIGH and XC02C_VOLT_LOW. These values are written with MDIS descriptors and are not to be changed during normal operation. When the voltage is exceeding this range, the display is switched off for protection.

The output voltage is measured using the microcontroller internal ADC function. The ADC value which represents the output voltage can be read via the SMBus command *XC02C_VOLT* (see Table 22, SMBus command for voltage supervision function, on page 33. With an ADC reference voltage of 3.00 volts the returned value from this command is to be interpreted as

$$U_{\mathrm{mon}} = \frac{ADC}{255} x 3000mV$$

so that for example a returned value of 0xD5 corresponds to (0xD5/255)*3000mV = 2.506V. This value results from the voltage divider tap between a 10k and 2.7k resistor (factor 0.212), so the real output voltage of the DC/DC converter is 2.506V/ 0.212 = 11.8V. This would be a typical output under load.

Table 22. *SMBus command for voltage supervision function*

Name	Command Code	Data Range	Type	Description
XC02C_VOLT	0x14	0x00.. 0xFF	r	DC/DC output (voltage divider factor = 0,212)
XC02C_VOLT_LOW	0x22	0x00.. 0xFF	r/w	Minimum allowed display supply voltage
XC02C_VOLT_HIGH	0x21	0x00.. 0xFF	r/w	Maximum allowed display supply voltage

3.2.9 Temperature Supervision

The microcontroller is able to determine the temperature inside the DC2. The CPU can read the current temperature via the SMBus command *XC02C_TEMP*. This is independent from the temperature sensor and supervision functionality of the DC2's embedded system core itself.

The temperature supervision is carried out by the temperature sensor LM50. The LM50 is a precision integrated-circuit temperature sensor that can sense a -40°C to +125°C temperature range. It converts its temperature to an analog voltage according to the formula below:

OUTPUT

Vout=(10mV/°C x Temp °C) + 500 mV

Vout=+1.750mV at +125°C

Vout=+750mV at +25°C

Vout=+100mV at -40°C

This voltage is also converted as explained in Chapter 3.2.8 Voltage Supervision, but directly attached to the ADC channel since it is within the maximum ADC range of 3,000V. The Table 24. Temperature representation shows some values (which are derived by (Vout/3000mV) x 0xFF).

Table 23. *SMBus commands for temperature supervision*

Name	Command Code	Data Range	Type	Description
XC02C_TEMP	0x12	0x00.. 0xFF	r	Converted temperature
XC02C_TEMP_LOW	0x18	0x00.. 0xFF	r/w	Minimum temperature value
XC02C_TEMP_HIGH	0x13	0x00.. 0xFF	r/w	Maximum temperature value

The default values are -10 to +60° and can be changed at MEN depending on the display type.

When changing these settings manually do not exceed the panel's maximum operating temperature range of -30 to +70°C!

Table 24. *Temperature representation*

Value	Temperature
0x22	-10°C
0x2a	0°C
0x55	+50°C

3.2.10 Display Backlight Power and Brightness Control

The microcontroller can control the display's backlight brightness and switch the display backlight power on and off (i.e., to prevent display operation outside its specified temperature ranges).

The brightness is controlled using a PWM that can be adjusted in 0.5% steps by using values from 0x00 to 0xC8 (0 to 200).

The last command, XC02C_INIT_DS, is used to control whether the display is switched on immediate after power on or whether it remains dark until the user application switches it on with a XC02C_SW_DISP command. This "silent boot" feature allows application testing and entering values in the BIOS of the onboard CPU. When the application is deployed, the initial display state can be set to off so that BIOS and OS boot messages do not appear in the field.

Table 25. *SMBus commands for display control*

Name	Command Code	Data Range	Type	Description
XC02C_SET_BR	0x17	0x00.. 0xC8	r/w	Set/get brightness level
XC02C_SW_DISP	0x20	0x00.. 0x01	r/w	Switch display on (1) or off (0)
XC02C_BR_SRC	0x19	0x00.. 0x01	r/w	Brightness source: SMB command = 0 Photo diode = 1
XC02C_INIT_DS	0x25	0x00.. 0x01	r/w	Initial display state at powerup: on = 0 off = 1

3.2.11 Optional Autonomous Brightness Control with Photo Diode

When the DC2 is equipped with a photo diode for light detection the firmware allows to pass brightness control to it. The command XC02C_BR_SRC switches control from brightness setting with the SMB command XC02C_SET_BR to autonomous setting. In this case the value is updated every 5s so short coverages of the diode don't affect brightness.

To keep the same version of the firmware for all DC2 variants, its also possible to switch to autonomous brightness control when there no photo diode is present. In that case the brightness will always stay the same.

3.2.12 Miscellaneous Commands

The firmware supports some commands that are useful to retrieve information about the build date and time.

With each call to the command *XC02C_TIMESTAMP* the firmware returns one character of the build timestamp string that is stored in the microcontroller's internal EEPROM. This helps to identify the firmware version. The values returned are concatenated in the MDIS driver and logged when the MDIS device that represents the microcontroller is opened.

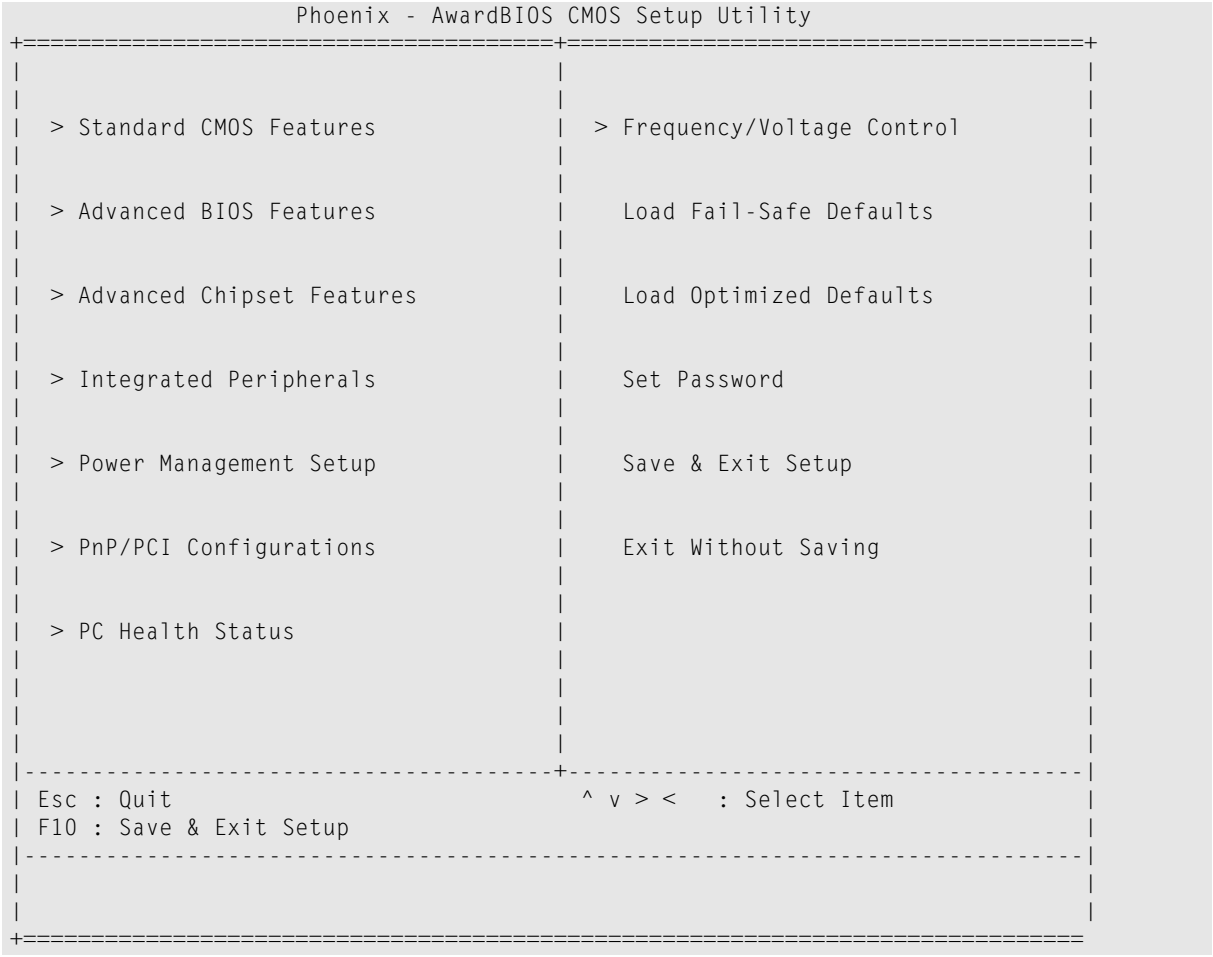
The command *XC02C_ID* returns a fixed value 0xC2 that is used to identify the underlaying carrier board type. See Table 26, SMBus commands for PSU ID and firmware revision number, on page 35.

Table 26. *SMBus commands for PSU ID and firmware revision number*

Name	Command Code	Data Range	Type	Description
XC02C_ID	0xFE	0xC2	r	Fixed firmware ID
XC02C_TIMESTAMP	0x20	0x00.. 0x01	r	Build date string, one character at a time

4 BIOS

4.1 Main Menu



The ">" character in front of a menu item means that a sub-menu is available. An "x" in front of a menu item means that there is a configuration option which needs to be activated through a higher configuration option before being accessible.

4.2 Standard CMOS Features

```
                    Phoenix - AwardBIOS CMOS Setup Utility
                             Standard CMOS Features
+=================================================+=======================+
|    Date (mm:dd:yy)            Mon, Jan 23 2008  |         Item Help     |
|    Time (hh:mm:ss)            10 : 57 : 22      |-----------------------|
|                                                 | Menu Level   >        |
|  > IDE Channel 0 Master      [ None]            |                       |
|  > IDE Channel 0 Slave       [ None]            |                       |
|                                                 |                       |
|                                                 |                       |
|    Base Memory                   640K           |                       |
|    Extended Memory             2086912K         |                       |
|    Total Memory                2087936K         |                       |
|                                                 |                       |
|                                                 |                       |
+=================================================+=======================+
     F5: Previous Values    F6: BIOS Default Values    F7: Last Saved Values
```

Date (mm:dd:yy)

Description	Change the day, month, year and century.	
Options	*mm*	Month
	dd	Day
	yy	Year

Time (hh:mm:ss)

Description	Change the internal clock.	
Options	*hh*	Hours
	mm	Minutes
	ss	Seconds

IDE Channel 0/1 Master/Slave — Sub-menu

```
IDE HDD Auto-Detection    [Press Enter]

IDE Channel 0 Master      [Auto]
Access Mode               [Auto]

Capacity                       0 MB

Cylinder                       0
Head                           0
Precomp                        0
Landing Zone                   0
Sector                         0
```

IDE HDD Auto-Detection		
Description	Auto-detects the HDD's size, head etc. on this channel.	
Options	None	

IDE Channel 0/1 Master/Slave		
Options	*None*	*Manual*
	Auto	

Access Mode		
Options	*CHS*	*Large*
	LBA	*Auto*

Capacity / Cylinder / Head / Precomp / Landing Zone / Sector	
Options	None

Base Memory / Extended Memory / Total Memory

Description	You cannot change any values in the Memory fields. They are only for information.

4.3 Advanced BIOS Features

```
                    Phoenix - AwardBIOS CMOS Setup Utility
                           Advanced BIOS Features
+=================================================+=======================+
|  > CPU Feature                [Press Enter]     |        Item Help      |
|  > Hard Disk Boot Priority    [Press Enter]     |-----------------------|
|    CPU L1 & L2 Cache          [Enabled]         | Menu Level   >        |
|    Hyper-Threading Technology[Enabled]          |                       |
|    Quick Power On Self Test   [Enabled]         |                       |
|    First Boot Device          [Hard Disk]       |                       |
|    Second Boot Device         [ZIP100]          |                       |
|    Third Boot Device          [LS120]           |                       |
|    Boot Other Device          [Enabled]         |                       |
|    LAN-Boot ROM               [Disabled]        |                       |
|    Boot Up NumLock Status     [On]              |                       |
|    Security Option            [Setup]           |                       |
|  x APIC Mode                  [Enabled]         |                       |
|    MPS Version Control For OS[1.4]              |                       |
|    OS Select For DRAM > 64MB [Non-OS2]          |                       |
|    HDD S.M.A.R.T Capability   [Disabled]        |                       |
|    Full Screen LOGO Show      [Disabled]        |                       |
|    Summary Screen Show        [Disabled]        |                       |
|                                                 |                       |
|                                                 |                       |
|                                                 |                       |
+=================================================+=======================+
     F5: Previous Values    F6: BIOS Default Values    F7: Last Saved Values
```

CPU Feature — Sub-menu

```
Thermal Management        [Thermal Monitor 2]
Limit CPUID MaxVal        [Disabled]
C1E Function              [Disabled]
CPU C State Capability    [Disabled]
On-Demand TCC             [Disabled]
Execute Disable Bit       [Enabled]
Virtualization Technology [Enabled]
```

Thermal Management

Description	Shows the active thermal management.	
Options	*Thermal Monitor 1*	On die throttling
	Thermal Monitor 2	Ratio & VID transition
	TM1 + TM2 enabled	
	Disabled	

Limit CPUID MaxVal

Description	Set Limit CPUID MaxVal to 3, should be disabled for WinXP	
Options	*Disabled*	*Enabled*

C1E Function

Description	Enables the Enhanced Halt State for power saving	
Options	*Disabled*	*Auto*

CPU C State Capability		
Description	User can select the lowest C state supported according to CPU and MB	
Options	*Disabled*	*C2*
	C4	*C6*

On-Demand TCC		
Description	When enabled, it indicates the clock on to clock off interval ratio.	
Options	*Disable*	*50.0%*
	12.5%	*62.5%*
	25.0%	*75.0%*
	37.5%	*87.5%*

Execute Disable Bit		
Description	When disabled, forces the XD feature flag to always return 0.	
Options	*Enabled*	*Disabled*

Virtualization Technology		
Description	When enabled, a VMM can utilize the addional hardware capabilities provided by Vanderpool Technology. (Not available for DC2 versions with the Atom Z510P/PT processor.)	
Options	*Enabled*	*Disabled*

Hard Disk Boot Priority — Sub-menu

```
1. USB-HDD0  : Intel Value SSD
2. USB-HDD1  : Intel Value SSD
3. USB-HDD2  : SanDisk Cruzer Micro
2. Bootable Add-in-Cards

Boot priority [Dynamic]
```

Description	Selects the boot device priority of any hard disk recognized.	
Options	*Dynamic*	New detected devices are added to the end of the boot-list.
	Manual	The chosen setting is saved as long as the HDD configuration of the system is not changed. (This setting is advantageous if there is no battery in the system).
	Fixed	The BIOS scans the IDE controller and always fixes the boot sequence: 1. HDD from 1st controller 2. HDD from 2nd controller 3. USB-HDD devices

CPU L1 & L2 Cache

Description	Allows to enable or disable the processor cache memory. You should disable cache only if absolutely necessary, e.g. for testing purposes, since this slows down the system considerably.	
Options	*Enabled*	*Disabled*

Hyper-Threading Technology

Description	Enabled for Windows XP and Linux 2.4.x (OS optimized for Hyper Threading Technology) and Disable for other OS (OS not optimized for Hyper Threading Technology). (Not available for DC2 versions with the Atom Z510P/PT processor.)	
Options	*Enabled*	*Disabled*

Quick Power On Self Test

Description	Allows the system to skip certain tests while booting. This will decrease the time needed to boot the system.	
Options	*Enabled*	*Disabled*

First Boot Device / Second Boot Device / Third Boot Device

Description	Selects your boot device priority.		
Options	*LS120*	*ZIP100*	*USB-CDROM*
	Hard Disk	*USB-FDD*	*Legacy LAN*
	CDROM	*USB-ZIP*	*Disabled*

Boot Other Device

Description	Selects your boot device priority.	
Options	*Enabled*	*Disabled*

LAN-Boot ROM

Description	*1x*: The option ROM for PXE[1] LAN boot is called once, then the boot procedure continues with the normal boot order. *Endless*: The option ROM for PXE LAN boot is called until it is successful, i.e. until an operating system is booted over LAN (This function is available as of BIOS version 1.11; the special BIOS version with RAID support does not support network boot.)	
Options	*Disabled*	*Endless*
	1x	

[1] Preboot Execution Environment. PXE provides a way for a system to initiate a network connection to various servers prior to loading an OS. This network connection supports a number of standard IP protocols such as DHCP and TFTP, and can be used for purposes such as software installation and system inventory maintenance.

Boot Up NumLock Status

Description	Selects power on state for NumLock.	
Options	*Off*	*On*

Security Option

Description	Selects whether the password is required every time the system boots or only when you enter setup.	
Options	*Setup*	*System*

APIC Mode

Description	APIC mode extends the number of available IRQs (up to 23 IRQs) for operating systems which can use this (Windows XP/2000).	
Options	*Enabled*	

MPS Version Control For OS

Description	Selects the multiprocessor specification (MPS) revision.	
Options	*1.4*	*1.1*

OS Select For DRAM > 64MB

Description	Select OS2 only if you are running an OS/2 operating system with greater than 64MB of RAM on the system.	
Options	*Non-OS2*	*OS2*

HDD S.M.A.R.T Capability

Description	Enables the hard disk drive S.M.A.R.T capability. The Self Monitoring Analysis And Reporting technology monitors the hard disk's condition and allows early prediction and warning of the hard disk failing. In order to use S.M.A.R.T you have to enable it and keep the S.M.A.R.T.-aware hardware monitoring utility running in the background all the time.	
Options	*Disabled*	*Enabled*

Full Screen LOGO Show

Description	Reserved to select between boot logos.	
Options	*Disabled*	

Summary Screen Show

Description	Show summary screen	
Options	*Enabled*	*Disabled*

4.4 Advanced Chipset Features

You should make changes in this menu only if you have thorough knowledge of your system! Setting wrong values in this section may cause the system to malfunction!

```
                    Phoenix - AwardBIOS CMOS Setup Utility
                          Advanced Chipset Features
+=====================================================+=======================+
|    DRAM Timing Selectable     [By SPD]              |        Item Help      |
|     System BIOS Cacheable     [Enabled]             |-----------------------|
|     Video BIOS Cacheable      [Disabled]            | Menu Level   >>       |
|                                                     |                       |
|                                                     |                       |
|    ** VGA Setting **                                |                       |
|    On-Chip Frame Buffer Size  [8MB]                 |                       |
|    Boot Type                  [LVDS]                |                       |
|    LCD Panel Type             [1024x768 generic]    |                       |
|    Panel Scaling              [Auto]                |                       |
|    BIA Control                [VBIOS Default]       |                       |
|    TV Feature                 Press Enter           |                       |
|                                                     |                       |
+=====================================================+=======================+
     F5: Previous Values    F6: BIOS Default Values    F7: Last Saved Values
```

DRAM Timing Selectable

Description	Sets the method by which the DRAM timing is selected. If *By SPD* is selected, the values for the following five items are configured from the contents of the SPD (Serial Presence Detect) device.
Options	*By SPD*

System BIOS Cacheable

Description	Selecting *Enabled* allows caching of the system BIOS ROM at 0xF0000 to 0xFFFFF, resulting in better system performance.
Options	*Enabled* *Disabled*

Video BIOS Cacheable

Description	Selecting *Enabled* allows caching of the video BIOS ROM at 0xC0000 to 0xCFFF, resulting in better video performance.
Options	*Enabled* *Disabled*

VGA — On-Chip Frame Buffer Size

Description	Controls the pre-allocated memory for frame buffer
Options	*1MB* *8MB* *4 MB*

VGA — Boot Type

Description	Selects the video device that will be activated during POST
Options	*VBIOS Default* *SDVO* *LVDS*

VGA — LCD Panel Type

Description	Selects the LCD panel used by the internal graphics device by selecting the appropriate setup item. Some panels are not numbered due to size constraints	
Options	*640x480 generic*	*1024x600 TMD 5.61"*
	800x600 generic	*1024x600 Samsung 4.8"*
	1024x768 generic	*1024x768 Samsung 15"*
	640x480 NEC 8.4 "	*1024x768 Sharp 7.2"*
	800x480 NEC 9"	*1280x800 Samsung 15.4*

VGA — Panel Scaling

Description	Controls the type of panel scaling
Options	*Auto*

VGA — BIA Control

Description	Selects BIA control and aggressiveness level through this setup item
Options	*VBIOS Default*

4.5 Integrated Peripherals

```
                    Phoenix - AwardBIOS CMOS Setup Utility
                              Integrated Peripherals
+=================================================+=======================+
|  > On-Chip IDE Device        [Press Enter]      |        Item Help      |
|  > Onboard Device            [Press Enter]      |-----------------------|
|  > PCI Express Root Port Func[Press Enter]      | Menu Level   >        |
|  > USB Device Setting        [Press Enter]      |                       |
|                                                 |                       |
|                                                 |                       |
+=================================================+=======================+
     F5: Previous Values    F6: BIOS Default Values    F7: Last Saved Values
```

On-Chip IDE Device — Sub-menu

```
IDE HDD Block Mode        [Enabled]
On-Chip Primary PCI IDE   [Enabled]
IDE Primary Master PIO    [Auto]
IDE Primary Slave  PIO    [Auto]
IDE Primary Master UDMA   [Auto]
IDE Primary Slave  UDMA   [Auto]
Delay for HDD (Secs)      [0]
```

IDE HDD Block Mode

Description	If your IDE hard drive supports block mode, select *Enabled* for automatic detection of the optimal number of block read/writes per sector the drive can support.	
Options	*Enabled*	*Disabled*

On-Chip Primary PCI IDE

Description	The integrated peripheral controller contains an IDE interface with support for two IDE channels. Select *Enabled* to activate each channel.	
Options	*Enabled*	*Disabled*

IDE Primary Master/Slave PIO

Description	These fields allow your system hard disk controller to work faster. Rather than have the BIOS issue a series of commands that transfer to or from the disk drive, PIO (Programmed Input/Output) allows the BIOS to communicate with the controller and CPU directly. The system supports five modes, numbered from 0 to 4, which primarily differ in timing. When *Auto* is selected, the BIOS will select the best available mode.		
Options	*Auto*	*Mode 1*	*Mode 3*
	Mode 0	*Mode 2*	*Mode 4*

IDE Primary Master/Slave UDMA			
Description	These fields allow your system to improve disk I/O throughput to up to 100MB/s with the Ultra DMA/100 feature.		
Options	*Auto*	*Disabled*	*UDMA33*
	UDMA66	*UDMA100*	

Delay for HDD	
Description	This feature allows users to set a higher delay for HDD detection
Options	*0-15 seconds*

Onboard Device — Sub-menu

```
Intel HD Audio Controller [Auto]
USB Client Controller     [Enabled]
Watchdog                  [Disabled]
Onboard LAN 1 Controller  [Enabled]
```

Intel HD Audio Controller		
Description	Enables/disables the audio controller.	
Options	*Auto*	*Disabled*

USB Client Controller		
Description	Enables/disables the USB client controller.	
Options	*Enabled*	*Disabled*

Watchdog			
Description	If the watchdog is active the system will be rebooted after the configured time when no application triggers the watchdog		
Options	*Disabled*	*1 min*	*2 min*
	5 min	*10 min*	*15 min*
	20 min	*30 min*	

Onboard LAN 1 Controller		
Description	Enables/disables the onboard LAN controller by setting this item to the desired value.	
Options	*Enabled*	*Disabled*

PCI Express Root Port Func — Sub-menu

```
PCI Express Port 1        [Auto]
PCI Express Port 2        [Auto]
```

PCI Express Port 1/2		
Description	Controls the activity of the PCI Express ports.	
Options	*Enabled*	*Disabled*
	Auto	

USB Device Setting — Sub-menu

```
USB 1.0 Controller       [Enabled]
USB 2.0 Controller       [Enabled]
USB Operation Mode       [High Speed]
USB Keyboard Function    [Enabled]
USB Storage Function     [Enabled]

***USB Mass Storage Device Boot Setting***
Intel Value SSD 2.00     [Auto Mode]
Intel Value SSD 2.00     [Auto Mode]
SanDisk Cruzer Micro 0.1 [Auto Mode]
```

USB 1.0 Controller

Description	Enables/disables the Universal Host Controller interface for USB.	
Options	*Enabled*	*Disabled*

USB 2.0 Controller

Description	Enables/disables the Enhanced Host Controller interface for USB.	
Options	*Enabled*	*Disabled*

USB Operation Mode

Description	Auto-selects USB device operation mode	
Options	*High Speed*	If the USB device is a high speed device, it operates in high-speed mode. If the USB device is a full/low-speed device, it operates in full/low speed mode
	Full/Low Speed	All USB devices operate on full/low speed mode.

USB Keyboard Function

Description	Enables/disables the USB Keyboard Function.	
Options	*Enabled*	

USB Storage Function

Description	Enables/disables the legacy support of USB Mass Storage	
Options	*Enabled*	*Disabled*

Intel Value SSD 2.00/SanDisk Cruzer Micro 0.1

Description	Selects the boot up type for the USB SSD	
Options	*Auto mode*	According to contents of USB mass storage device
	FDD mode	USB mass storage device boots up as floppy disk
	HDD mode	USB mass storage device boots up as hard disk

4.6 Power Management Setup

```
                    Phoenix - AwardBIOS CMOS Setup Utility
                           Power Management Setup
+=====================================================+=======================+
|    Power-Supply Type          [AT]                  |        Item Help      |
|    ACPI Function              [Enabled]             |-----------------------|
|    ACPI Suspend Type          [S3(STR)]             | Menu Level   >        |
|    Soft-Off by PWR-BTTN       [Instant-Off]         |                       |
|    PWRON After PWR-Fail       [On]                  |                       |
|    ATX_PWRGD Failure Mode     [Check at Startup]    |                       |
|  > HPET Feature               [Press Enter]         |                       |
|  > Intel DTS Feature          [Press Enter]         |                       |
|                                                     |                       |
+=====================================================+=======================+
     F5: Previous Values    F6: BIOS Default Values    F7: Last Saved Values
```

Power-Supply Type

Description	Selects the type of power supply.	
Options	*AT*	*ATX*

ACPI Function

Description	Enables/disables support of ACPI (Advance Configuration and Power Interface).	
Options	*Enabled*	

ACPI Suspend Type

Description	Selects the ACPI state used for System Suspend.	
Options	*S3(STR)*	Activates "Suspend To RAM" function.

Soft-Off by PWR-BTTN

Description	This field defines the power-off mode when using an ATX power supply. The *Instant-Off* mode allows powering off immediately upon pressing the power button. In the *Delay 4 Sec.* mode, the system powers off when the power button is pressed for more than four seconds or enters the suspend mode when pressed for less than 4 seconds.	
Options	*Instant-Off*	*Delay 4 Sec.*

PWRON After PWR-Fail

Description	Sets the system power status when power returns to the system from a power failure situation.		
Options	*Former-Sts*	*On*	*Off*

ATX_PWRGD Failure Mode

Description	Determines the system behaviour in case of a failure at the ATX power good signal.	
Options	*Check at start up*	*Check always*

HPET Feature — Sub-menu

```
HPET Support          [Enabled]
```

HPET Support

Description	Enables/disables the high-precision event timer in the chipset.	
Options	*Enabled*	*Disabled*

Intel DTS Feature — Sub-menu

```
Intel DTS Function                [Enabled]
x DTS Active temperature          55°C
x Passive Cooling Trip Point      95°C
x Passive TC1 Value               2
x Passive TC2 Value               0
x Passive TSP Value               10
  Critical Trip Point             POR
```

Intel DTS Function

Description	Enables/disables Intel DTS Function.	
Options	*Enabled*	*Disabled*

DTS Active temperature/Passive Cooling Trip Point/Passive TC1 Value/Passive TC2 Value/Passive TSP Value

Description	These values are read-only values as monitored by the system when the Intel DTS Feature is enabled.	
Options	*None*	

Critical Trip Point

Description	This value controls the temperature of the ACPI Critical Trip Point; i.e. the point at which the operating system will shut down the system.		
Options	*POR (POR = 100°C)*	*15°C*	*23°C*
	31°C	*39°C*	*47°C*
	55°C	*63°C*	*71°C*
	79°C	*87°C*	*95°C*
	103°C	*111°C*	*119°C*
	127°C		

4.7 PNP/PCI Configurations

```
                    Phoenix - AwardBIOS CMOS Setup Utility
                              PnP/PCI Configurations
+=====================================================+=======================+
|    Init Display First        [Onboard]              |        Item Help      |
|    Reset Configuration Data  [Disabled]             |-----------------------|
|                                                     | Menu Level   >        |
|    Resources Controlled By   [Auto(ESCD)]           |                       |
|  x IRQ Resources             [Press Enter]          |                       |
|                                                     |                       |
|    PCI/VGA Palette Snoop     [Disabled]             |                       |
|    PCI Latency Timer(CLK)    [ 32]                  |                       |
|                                                     |                       |
|    ** PCI Express relative items **                 |                       |
|    Maximum Payload Size      [128]                  |                       |
|                                                     |                       |
+=====================================================+=======================+
     F5: Previous Values    F6: BIOS Default Values    F7: Last Saved Values
```

Init Display First

Description	Selects which graphics controller the system initializes when the system boots.	
Options	*PCI Slot*	*Onboard*

Reset Configuration Data

Description	Select *Enabled* to reset Extended System Configuration Data (ESCD) when you exit Setup if you have installed a new add-on and the system reconfiguration has caused such a serious conflict that the OS cannot boot. *Disabled* is the default.	
Options	*Enabled*	*Disabled*

Resources Controlled By

Description	BIOS can automatically configure all the boot and Plug&Play compatible devices. If you choose *Auto*, you cannot select IRQ, DMA and memory base address fields, since BIOS automatically assigns them.	
Options	*Auto(ESCD)*	*Manual*

IRQ Resources

Description	When resources are controlled manually, you must assign each system interrupt a type depending on the type of device using the interrupt, i.e. either a PCI/ISA Plug&Play device (default) or a Legacy ISA device.

PCI/VGA Palette Snoop

Description	Some non-standard VGA display cards may not show colors properly. This field allows you to set whether or not MPEG ISA/VESA VGA cards can work with PCI/VGA. When this field is enabled, a PCI/VGA can work with an MPEG ISA/VESA VGA card. When this field is disabled, a PCI/VGA cannot work with an MPEG ISA/VESA card.
Options	*Enabled* *Disabled*

PCI Latency Timer (CLK)

Description	This BIOS feature controls how long a PCI device can hold the PCI bus before another takes over. The longer the latency, the longer the PCI device can retain control of the bus before handing it over to another PCI device. Normally, the PCI Latency Timer is set to 32 cycles. This means the active PCI device has to complete its transactions within 32 clock cycles or hand it over to the next PCI device. For better PCI performance, a longer latency should be used, but a long latency can also reduce performance as the other PCI devices queuing up may be stalled for too long. The optimum latency time depends on your system configuration.
Options	Decimal value between 0 and 255

Maximum Payload Size

Description	Sets the maximum TLP payload size for the PCI Express devices. The unit is byte.
Options	*128*

4.8 PC Health Status

```
                    Phoenix - AwardBIOS CMOS Setup Utility
                                PC Health Status
+=================================================+=======================+
|    Current System Temp         41°C             |        Item Help      |
|    Current CPU1 Temperature    38°C             |-----------------------|
|                                                 | Menu Level   >        |
|                                                 |                       |
|                                                 |                       |
|                                                 |                       |
+=================================================+=======================+
     F5: Previous Values    F6: BIOS Default Values    F7: Last Saved Values
```

Current System Temp/Current CPU1 Temperature

Description	These values are read-only values as monitored by the system.

4.9 Frequency/Voltage Control

```
                    Phoenix - AwardBIOS CMOS Setup Utility
                          Frequency/Voltage Control
+=================================================+=======================+
|    Spread Spectrum             [Enabled]        |        Item Help      |
|    XPD Clock                   [Disabled]       |-----------------------|
|                                                 | Menu Level   >        |
|                                                 |                       |
|                                                 |                       |
+=================================================+=======================+
     F5: Previous Values    F6: BIOS Default Values    F7: Last Saved Values
```

Spread Spectrum

Description	Sets the value of the spread spectrum. If enabled, this setting improves CE behavior.	
Options	*Disabled*	*Enabled*

XPD Clock

Description	Enables the clock for the debug connector	
Options	*Disabled*	*Enabled*

4.10 Load Fail-Safe Defaults

If this option is selected, a verified factory setup is loaded.

On the first BIOS setup configuration, this loads safe values for setup that make the system boot up. This state is achieved again when the system is reprogrammed with the necessary parameters using the related Flash program.

4.11 Load Optimized Defaults

At the moment this option has the same effect as described for Load Fail-Safe Defaults.

If required, this option can be used to load optimized values, e.g. for the system to boot faster. These values have to be defined in the BIOS binary by the BIOS manufacturer. A special BIOS version is needed for this.

4.12 Set Password

This lets you set a password. Please note that this often leads to problems, since passwords are easily forgotten.

4.13 Save & Exit Setup

This option saves the settings made and exits setup.

4.14 Exit without Saving

This exits setup without saving any settings.

5 Organization of the System

5.1 Memory Mappings

5.1.1 Processor View of the Memory Map

The memory map is allocated dynamically and may vary depending on the system configuration.

Table 27. *Memory map – processor view*

Address Range	Function
0xFDF00000..0xFDF7FFFF	Video controller (VGA-compatible)
0xD8000000..0xDFFFFFFF	Video controller (VGA-compatible)
0xFDFC0000..0xFDFDFFFF	Video controller (VGA-compatible)
0xFDFFF000..0xFDFFFFFF	USB (Universal Serial Bus)-Controller
0xFDFF8000..0xFDFFBFFF	Microsoft UAA bus driver for High Definition Audio
0xFDB00000..0xFDBFFFFF	PCI standard-PCI-to-PCI-bridge
0xFDE00000..0xFDEFFFFF	PCI standard-PCI-to-PCI-bridge
0xFDBC0000..0xFDBDFFFF	Intel(R) 82574L Gigabit Network Connection #3
0xFDBFC000..0xFDBFFFFF	Intel(R) 82574L Gigabit Network Connection #3
0xFDD00000..0xFDDFFFFF	PCI standard-PCI-to-PCI-bridge
0xFDC00000..0xFDCFFFFF	PCI standard-PCI-to-PCI-bridge
0xFDFFE000..0xFDFFE3FF	Standard extended PCI-to-USB universal host controller
0xFED00000..0xFED003FF	High precision event timer
0xFED00000..0xFED003FF	System board
0xFFB80000..0xFFBFFFFF	Intel(R) 82802 firmware hub
0xE0000000..0xEFFFFFFF	Motherboard resources
0x0000..0x9FFFF	System board
0xFEC00000..0xFEC00FFF	System board
0xFED13000..0xFED1DFFF	System board
0xFED20000..0xFED8FFFF	System board
0xFEE00000..0xFEE00FFF	System board
0xFFB00000..0xFFB7FFFF	System board
0xFFF00000..0xFFFFFFFF	System board
0xA0000..0xBFFFF	PCI bus
0xA0000..0xBFFFF	VGASave
0xC0000..0xDFFFF	PCI bus
0xE0000..0xEFFFF	PCI bus
0xE0000..0xEFFFF	System board

Address Range	Function
0xF0000..0xFFFFF	PCI bus
0xF0000..0xFFFFF	System board
0x100000..0x1F5DFFFF	System board
0x1F5E0000..0x1F5FFFFF	System board
0x1F600000..0x1F6FFFFF	System board
0x1F700000..0xFEBFFFFF	PCI bus

5.1.2 I/O Memory Map

Table 28. *Memory map - I/O*

Address Range	Function
0x00000000..0x00000CF7	PCI bus
0x00000000..0x00000CF7	DMA controller
0x00000010..0x0000001F	Motherboard resources
0x00000020..0x00000021	Programmable interrupt controller
0x00000022..0x0000003F	Motherboard resources
0x00000040..0x00000043	System timer
0x00000044..0x0000005F	Motherboard resources
0x00000061..0x00000061	Standard speaker sound
0x00000062..0x00000063	Motherboard resources
0x00000065..0x0000006F	Motherboard resources
0x00000070..0x00000073	System CMOS/real time clock
0x00000074..0x0000007F	Motherboard resources
0x00000080..0x00000090	DMA controller
0x00000091..0x00000093	Motherboard resources
0x00000094..0x0000009F	DMA controller
0x000000A0..0x000000A1	Programmable interrupt controller
0x000000A2..0x000000BF	Motherboard resources
0x000000C0..0x000000DF	DMA controller
0x000000E0..0x000000EF	Motherboard resources
0x000000F0..0x000000FF	Numerical coprocessor
0x00000170..0x00000177	Secondary IDE channel
0x000001CE..0x000001CF	VgaSave
0x000001F0..0x000001F7	Primary IDE channel
0x00000274..0x00000277	ISAPnP data read port
0x00000279..0x00000279	ISAPnP data read port
0x000002E8..0x000002EF	VgaSave
0x00000376..0x00000376	Secondary IDE channel

Address Range	Function
0x000003B0..0x000003BB	VgaSave
0x000003C0..0x000003DF	VgaSave
0x000003F6..0x000003F6	Primary IDE channel
0x000004D0..0x000004D1	Motherboard resources
0x00000880..0x0000088F	Motherboard resources
0x00000900..0x000009BF	Motherboard resources
0x00000A79..0x00000A79	ISAPnP data read port
0x00000D00..0x0000FFFF	PCI bus
0x0000D000..0x0000DFFF	PCI standard-PCI-to-PCI-bridge
0x0000E000..0x0000EFFF	PCI standard-PCI-to-PCI-bridge
0x0000EF00..0x0000EF1F	Intel(R) 82574L Gigabit Network Connection #3
0x0000FB00..0x0000FB0F	Standard dual channel PCI-IDE controller
0x0000FC00..0x0000FC1F	Standard PCI-to-USB universal host controller
0x0000FD00..0x0000FD1F	Standard PCI-to-USB universal host controller
0x0000FE00..0x0000FE1F	Standard PCI-to-USB universal host controller
0x0000FF00..0x0000FF07	Video controller (VGA-compatible)

5.2 PCI Devices

Table 29. *PCI Devices*

Bus	Device Number	Device Function	Vendor ID	Device ID	Function
0	0x00	0x0	0x8086	0x8100	Host bridge
0	0x02	0x0	0x8086	0x8108	Display Controller
0	0x1A	0x00	0x8086	0x8118	USB Client Controller
0	0x1B	0x00	0x8086	0x811B	HD Audio Controller
0	0x1C	0x00	0x8086	0x8110	PCI Express Root Port 1
0	0x1C	0x01	0x8086	0x8110	PCI Express Root Port 2
0	0x1D	0x00	0x8086	0x8114	USB UHCI Controller 1
0	0x1D	0x01	0x8086	0x8115	USB UHCI Controller 2
0	0x1D	0x02	0x8086	0x8116	USB UHCI Controller 3
0	0x1D	0x07	0x8086	0x8117	USB EHCI Controller
0	0x1F	0x00	0x8086	0x8119	LPC Controller
0	0x1F	0x01	0x8086	0x811A	IDE Controller
1	0x00	0x00	0x8086	0x10D3	Onboard Ethernet Controller (on board versions with one PCI Express link on the ESM Express connector)

5.3 SMBus Devices

Table 30. *SMBus devices*

Address	Function
0x12	XC02BC board controller (BMC1)
0xD2 / 0xD3	Clock generator
0xA0	SPD data for system memory
0x60	Protected register
0x98	Thermal sensor
0x6E	Protected register
0x9A	XM01BC board controller (BMC2)
0xAA	Configuration EEPROM on XM1/XM1L
0xAE	Configuration EEPROM on XC2

5.4 Interrupt Mapping

Table 31. *Interrupts*

Interrupt	Function
IRQ 0	High precision event timer
IRQ 8	High precision event timer
IRQ 9	Microsoft ACPI-conformal system
IRQ 11	Video controller (VGA-compatible)
IRQ 11	USB (Universal Serial Bus) controller
IRQ 13	Numerical coprocessor
IRQ 14	Primary IDE channel
IRQ 16	Microsoft UAA bus driver for High Definition Audio
IRQ 16	PCI standard-PCI-to-PCI-bridge
IRQ 16	Intel(R) 82574L Gigabit Network Connection #3
IRQ 16	Standard PCI-to-USB universal host controller
IRQ 17	PCI standard-PCI-to-PCI-bridge
IRQ 17	Standard PCI-to-USB universal host controller
IRQ 18	Standard PCI-to-USB universal host controller
IRQ 19	Standard extended PCI-to-USB universal host controller

6 Appendix

6.1 Literature and Web Resources

- DC2 data sheet with up-to-date information and documentation:
  www.men.de/products/09DC02-.html

6.1.1 CPU

- Intel Processors
  www.intel.com

6.1.2 USB

- USB:
  Universal Serial Bus Specification Revision 1.0; 1996; Compaq, Digital Equipment Corporation, IBM PC Company, Intel, Microsoft, NEC, Northern Telecom
  www.usb.org

6.1.3 Ethernet

- ANSI/IEEE 802.3-1996, Information Technology - Telecommunications and Information Exchange between Systems - Local and Metropolitan Area Networks - Specific Requirements - Part 3: Carrier Sense Multiple Access with Collision Detection (CSMA/CD) Access Method and Physical Layer Specifications; 1996; IEEE
  www.ieee.org
- Charles Spurgeon's Ethernet Web Site
  Extensive information about Ethernet (IEEE 802.3) local area network (LAN) technology.
  www.ethermanage.com/ethernet/
- InterOperability Laboratory, University of New Hampshire
  This page covers general Ethernet technology.
  www.iol.unh.edu/services/testing/ethernet/training/

6.1.4 HD Audio

- Intel High Definition Audio:
  www.intel.com/design/chipsets/hdaudio.htm

6.2 Finding out the Product's Article Number, Revision and Serial Number

MEN user documentation may describe several different models and/or design revisions of the DC2. You can find information on the article number, the design revision and the serial number on a label attached to the system's rear.

- **Article number:** Gives the product's family and model. This is also MEN's ordering number. To be complete it must have 9 characters.
- **Revision number:** Gives the design revision of the product.

- **Serial number:** Unique identification assigned during production.

If you need support, you should communicate these numbers to MEN.

Figure 7. *Label giving the product's article number, revision and serial number*